IEEE/PES Transformers Committee
Spring 2007 Meeting
Dallas, Texas

"Transformer Life Expectancy"

– Technical Presentation –
(Part 1 of 2)
Monday, 12 March, 4:45 p.m.

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1. Abstract

This presentation is the first part of a two-part presentation on Transformer Life. In this first session, we will discuss transformer mortality models. On Tuesday afternoon, we will then discuss transformer condition assessment, and life cycle management.

The world went through massive industrial growth in the post World War II era, causing a large growth in base infrastructure industries. World energy consumption grew from 1 trillion to 11 trillion kwhr in the decades following the war. Most of this equipment is now in the aging part of its life cycle. According to U.S. Commerce Department data, the U.S. electric utility industry reached a peak in new transformer installations around 1973-74. In those two years, the US added about 185 GVA of power transformers.

Natural aging of the transformer insulation system reduces both the mechanical and dielectric withstand strength of a transformer. As the transformer operates, it is subjected to faults that result in high radial and compressive forces. As the load increases, with system growth, the operating stresses increase. In an aging transformer failure, typically the conductor insulation is weakened to the point where it can no longer sustain mechanical stresses of a fault. Turn-to-turn insulation then causes a dielectric failure, or a fault causes a loosening of winding clamping pressure, which reduces the transformer's ability to withstand future short circuit forces.

Although we have not yet seen an alarming increase in end of life failures, such a rise must be expected eventually. A risk model of future failures based on past installations and expected life cycle can be developed. One such risk model was published at a conference in 2000 and since then, has been revised a number of times. A newly revised risk model (2007 revision) will be presented at this session.

2. Learning Objectives

The tutorial will provide:

- Discussion on methods available today to estimate risk.
- Introduction of the transformer mortality risk forecasting
- A review of previous forecasts
- A practical approach for transformer owners to forecast their own future failures, based on age.

3. Learning Outcomes

As a result of attending of this tutorial session members will gain:

- An understanding of “risk” (a concept of frequency and severity) and how it relates to a fleet of aging transformers.
- An understanding of mortality models and failure forecasts, based on aging.
- An appreciation of the parameters that affect the operating risk of a fleet of transformers (age is not the only factor).
- A better understanding of the life cycle management choices that are available.

4. Presenter’s Biographies

William H. Bartley P.E.: Mr. Bartley is an Assistant Vice President and the Principal Electrical Engineer in the Engineering Department of The Hartford Steam Boiler Inspection and Insurance Company. Mr. Bartley earned a B.S. degree in Electrical Engineering from University of Missouri at Rolla, and has been employed by Hartford Steam Boiler since 1971. He is responsible for developing standards, OEM relations, fleet problems, repair procedure development, and new testing technologies. He is a Senior Member of IEEE and serves on both the Transformers Committee and Electric Machinery Committee. He is currently Vice Chair of the Generator Subcommittee /EMC, and holds leadership positions in several generator and transformer Working Groups. He lives in Newington, Connecticut.